PROJECT facts

U.S. Department of Energy
Office of Fossil Energy
National Energy Technology Laboratory

Sequestration

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Feasibility of Large-Scale CO_2 Ocean Sequestration

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Background

The disposal in the deep ocean of CO_2 generated by the combustion of fossil fuels has long been discussed as a speculative option for controlling greenhouse gas induced climate change. Although models of deep ocean sequestration have been formulated and laboratory simulations have been carried out, few direct oceanic experiments have been reported. With the availability of advanced Remotely Operated Vehicle (ROV) technology, it has now become possible to carry out controlled releases of many chemical species in the deep ocean, and to observe and measure the processes taking place.

The Monterey Bay Aquarium Research Institute (MBARI) is investigating the chemical, and physical behavior of, and biological responses to, hydrates on the sea floor at a depths up to 3,600 m. Many people are aware of methane hydrates, ice like complexes of water and methane, but are unaware that, under the proper conditions, CO_2 can also form hydrates. The storage of CO_2 in hydrate pools at the bottom of the ocean is being investigated. Four research cruises using the ROV to study CO_2 hydrate ocean storage off Monterey Bay have been completed. The physical chemistry and biological effects of hydrate formation have been studied in the deep ocean by means of small-scale batch experiments.

The research group at Washington University, with MBARI, is using *in situ* Raman spectroscopy to carry out the first direct in situ analysis on the sea floor of CO_2 hydrates, the entrained and surrounding fluids, and the sediments adjacent to the hydrates. Information on hydrate/sediment interaction is essential for the evaluation of ocean sequestration of CO_2.

Primary Project Goal

The primary goal of this project is to investigate the chemical, physical, and biological behavior of CO_2 hydrates in the deep ocean. These data are necessary to help evaluate the storing CO_2 in hydrate pools at the bottom of the ocean, a possibility under consideration.

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PROJECT PARTNERS

Monterey Bay Aquarium Research Institute (MBARI)

Washington University at St. Louis

COST

Total Project Value:	$1,263,755
DOE:	$ 970,041
Non-DOE Share:	$ 293,714

Objectives

Three field experiments will be conducted to study:

- Long term fate of CO_2 and CO_2 hydrates on the sea floor
- Biological responses to the disposed material
- Geochemical interactions with sediments and pore waters

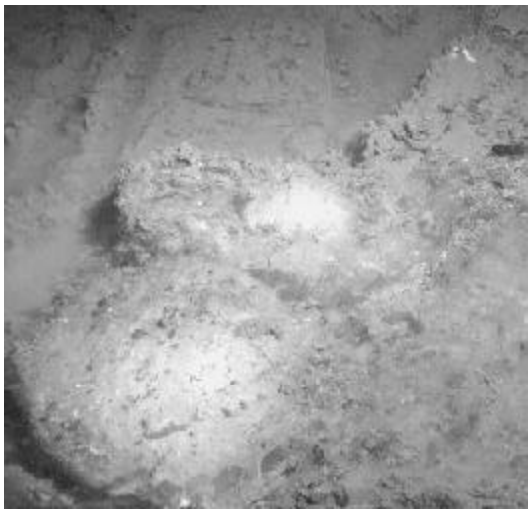
Accomplishments

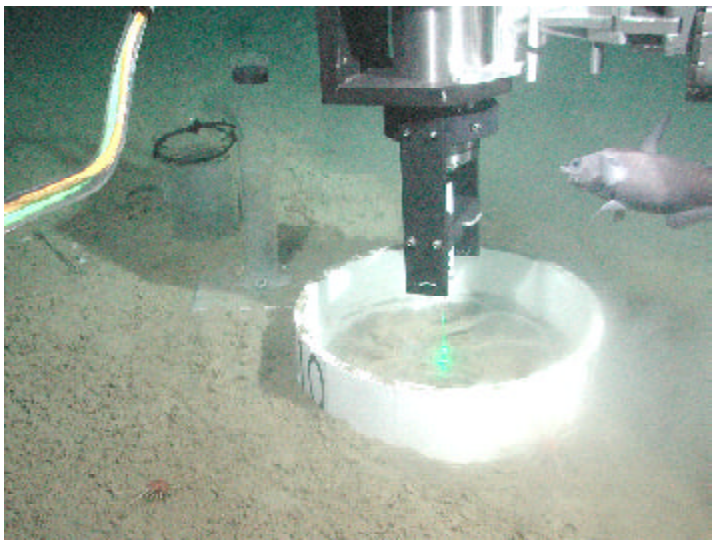
MBARI used a small scale delivery system with a capacity of 56 liters to study CO_2 interactions with the ocean. Four controlled delivery dives were executed with the CO_2 delivered to a central corral complex. Results showed a strong tidal periodicity in the water plume of lowered pH and a complex set of biological responses. Below a depth of about 3,000 m, the density of liquid CO_2 exceeds that of seawater, and the CO_2 is quickly converted into solid hydrate by reaction with the surrounding water.

Benefits

This project will provide further understanding of the behavior of CO_2 within the ocean environment. Hydrate pools at the bottom of the ocean have the potential for long-term storage of large quantities of CO_2.

Formation of CO_2 hydrate mounds at 3610 meters





Testing the waters: An experiment to investigate the fundamental science of ocean CO_2 sequestration at a depth of 3,600m off the coast of California. A small pool of liquid CO_2 is sensed by the beam of a laser Raman spectrometer to record the chemical status of the material. A laboratory beaker and measuring cylinder, also used for experiments are close by. A Pacific Grenadier fish observes the activity. This sea floor laboratory is controlled by a remotely operated vehicle.